4977

29 April 1981

JOURNAL OF THE KANSAS ENTOMOLOGICAL SOCIETY
54(2), 1981, pp. 269–277

Notes on the Biology of *Pheidole lamia* (Hymenoptera: Formicidae) at its Type Locality (Austin, Texas)[1]

DONALD H. FEENER, JR.[2]
Department of Zoology, University of Texas, Austin 78712

ABSTRACT: The rediscovery of *Pheidole lamia* at its type locality is reported, and several aspects of its biology are clarified: 1) *P. lamia* is not confined to undisturbed woodlands, but is also found in recently disturbed wooded habitat. 2) *P. lamia* is not rare in Austin, although its inconspicuous nesting sites and foraging habits make it appear so. 3) It is suggested that the size of Austin colonies is probably near 500–1000 minor workers, the same order of magnitude as colonies found in Florida.

In 1901, and more formally in 1908, William Morton Wheeler described *Pheidole lamia* from a small number of specimens collected in Austin, Texas. The major workers of this species are strikingly different from the major workers of all other North American members of *Pheidole*. The heads of *P. lamia* major workers are elongate, subcylindrical in cross section and obliquely truncated in front, closely resembling the phragmotic heads of *Camponotus* (*Colobopsis*) major workers. Wheeler believed colonies of *P. lamia* to be small, hypogaeic and, at least in the Austin area, very patchily distributed. Furthermore, he suggested that the major workers may serve a dual function. First, like *Camponotus* (*Colobopsis*) major workers, they may use their "phragmotic" heads to block the entrances to nest galleries. Second, due to the large size of their gasters and their small numbers (1–4) in a colony, the major workers may also function as the queen caste.

Until recently the validity of Wheeler's statements on *P. lamia* remained unchecked. *P. lamia* was not collected again until 1931 in Fayette, Mississippi (Smith, 1931) and for only a third time in 1954 in Decatur County, Georgia (Gregg, 1956). Creighton repeatedly searched for *P. lamia* in the Austin area without success (Gregg, 1956). These geographically disjunct collecting records led Gregg (1956) to suggest that *P. lamia* is extremely rare and patchily distributed throughout the southeastern United States. More recently, Buren et al. (1977) collected numerous colonies of this species in Leon County, Florida. Unlike the collections reported by Wheeler (1901, 1908), Smith (1931) and Gregg (1956), these colonies were not small

[1] A contribution from The University of Texas Brackenridge Field Laboratory, Austin, Texas.

[2] Present address, Department of Zoology, University of Iowa, Iowa City, Iowa 52242.

Received for publication 4 June 1980.

B

and contained over 200 major workers and 1000 minor workers. Furthermore, observations by Buren et al. (1977) suggested that the heads of *P. lamia* major workers are not phragmotic, but, instead, are specialized for subterranean warfare against marauding thief ants, *Solenopsis* (*Diplorhoptrum*) spp. Thus Wheeler appears to be mistaken on most of his conjectures regarding *P. lamia*.

Buren et al. (1977), following Gregg (1956), suggested that Austin, Texas is a geographical fringe area for *P. lamia,* and that this fact may account for its apparent rarity and small colony size at the type locality. In this paper I report the rediscovery of *Pheidole lamia* at its type locality and present evidence that suggests this species is more common than previously thought and may maintain large colonies in this geographical "fringe area."

Study Area and Methods

I made all observations and collections at The University of Texas Brackenridge Field Laboratory, Austin, Texas. This area, adjacent to the Colorado River, is a 32 hectare tract of semi-deciduous woodland in various stages of secondary succession. Residential structures stood on some of this land as late as 1960. The woodland is chiefly composed of oak (*Quercus fusiformis* and *Q. texana*), hackberry (*Celtis reticulata* and *C. laevigata*), cedar elm (*Ulmus crassifolia*) and post cedar (*Juniperus ashei*). In general the litter in this woodland is largely composed of *U. crassifolia* and *Q. fusiformis* leaves.

To determine the composition of the litter-foraging ant fauna I established two 100 m transects and four 10 m × 10 m quadrats in 5 separate areas of the woodland. Transect 1 passed through Quadrat 2. All of these areas were in the same stage of secondary succession. Both transects contained 10 sites 10 m apart with 5 sampling stations per site. The 5 sampling stations were at the corners and center of squares 1.5 m on a side. Each of the 10 m × 10 m quadrats contained 81 sampling stations 1 m apart. In August 1975 I collected one 25 cm × 25 cm litter sample at each sampling station along both transects and extracted the arthropods using Berlese funnels. All litter was then returned to the appropriate stations. In 1976 and 1977, from mid-April until late October, I monitored spatial distributions and activity patterns of ant species along these transects by tunafish baiting at the same stations where litter samples were collected in 1975. In summer 1979 I monitored diel activity patterns by baiting for 24 hour periods in each of the 4 quadrats. I always placed tuna baits on the surface of the litter.

Results

Pheidole lamia appears to be widely distributed within the oak-hackberry woodland at Brackenridge Field Laboratory. I found workers along both transects and in all 4 quadrats. Moreover, the distribution of workers along

Table 1. Abundance of ant species found in litter samples taken along Transects 1 and 2. Each transect contains 10 sites and 50 sampling stations.

Species	No. sites occupied	No. samples occupied	No. workers per sample occupied	
			Mean	Range
T1				
Solenopsis texana	10	39	7.08	1–28
Pheidole dentata	10	27	1.74	1–5
Leptothorax terrigena	7	13	3.54	1–15
Myrmecina americana	7	13	1.85	1–4
Pheidole lamia	5	6	4.00	1–10
Crematogaster punctulata	4	8	2.71	1–6
Hypoponera sp. 1	3	3	1.33	1–2
Monomorium minimum	2	4	1.25	1–2
Crematogaster laeviuscula	1	1	1.00	—
Macromischa subditva	1	1	1.00	—
Paratrechina melanderi	1	1	1.00	—
Strumigenys sp.	1	1	1.00	—
T2				
Solenopsis texana	10	44	9.57	1–32
Leptothorax terrigena	10	22	2.77	1–13
Pheidole dentata	10	18	1.39	1–3
Pheidole lamia	7	10	2.00	1–4
Crematogaster punctulata	7	9	3.78	1–26
Hypoponera sp. 1	4	8	2.38	1–10
Macromischa subditva	3	4	1.00	—
Myrmecina americana	2	2	1.50	1–2
Paratrechina melanderi	2	2	1.50	1–2
Crematogaster laeviuscula	1	2	1.00	—
Camponotus americana	1	1	1.00	—
Hypoponera sp. 2	1	1	1.00	—
Solenopsis geminata	1	1	1.00	—

the transects and within the quadrats suggests that colonies of *P. lamia* may be quite numerous.

DISTRIBUTION AND ABUNDANCE IN TRANSECT LITTER SAMPLES: Data on the abundance and distribution of ant species based on litter samples are summarized in Table 1. I found 12 species in samples collected along Transect 1 (T1) and 13 species in samples from Transect 2 (T2). *P. lamia* workers were present in 6 samples from T1 and 10 samples from T2. Using the criterion of presence or absence in a litter sample, *P. lamia* is the sixth most common species along T1 and the fourth most common species from T2. Mean number of workers per sample gives comparable rankings (Table 1). By both measures *P. lamia* is more common than half the ant species present.

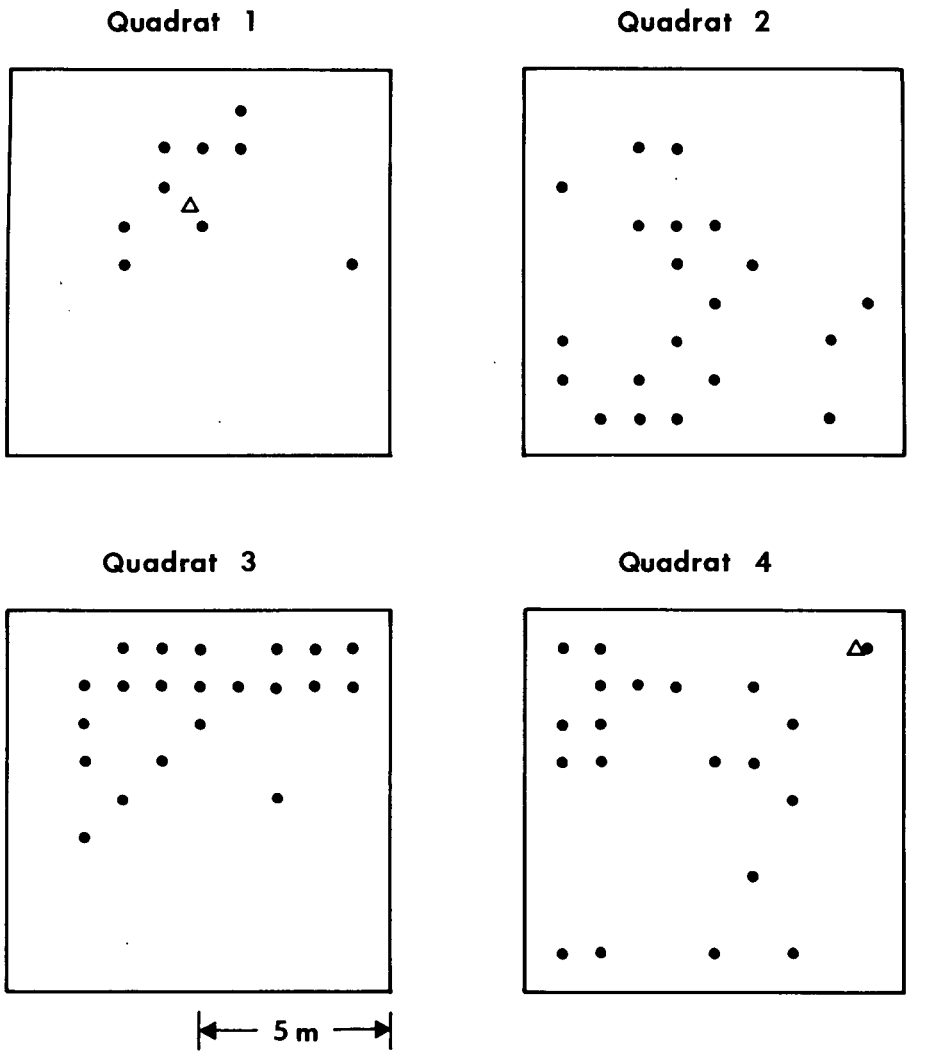

Fig. 1. Bait stations attracting *Pheidole lamia* during 24 hour censuses. Each quadrat contained 81 bait stations set 1 m apart. Solid circle = occupied bait station, open triangle = nest entrance.

The spatial distributions of litter samples containing *P. lamia* suggests that several colonies were present along each transect. The 6 litter samples from T1 were distributed among 5 sites while the 10 samples from T2 were distributed among 7 sites (Table 1). Since all sites were separated by 10 m and it is unlikely that *P. lamia* workers forage over such great distances, the presence of workers in each site probably represents a distinct colony.

Table 2. Distribution and abundance of *P. lamia* at tuna baits in Transect 1 (T1) and Transect 2 (T2).

Seasonal totals	T1		T2	
	1976	1977	1976	1977
Number of days baited	7	10	6	9
Number of days *P. lamia* observed at baits	4	7	6	7
Number of stations attracting *P. lamia*	4	10	20	19
Number of sites attracting *P. lamia*	3	4	8	7
Number of baits/day attracting *P. lamia*				
Mean	1.25	2.57	5.67	6.00
Range	1–2	1–6	2–9	3–12

Thus a conservative estimate suggests that there are at least 5 *P. lamia* colonies along T1 and 7 colonies along T2.

DISTRIBUTION AND ABUNDANCE AT TRANSECT BAIT STATIONS: In contrast to litter samples, I encountered *P. lamia* at tuna baits more rarely than most other ant species. Along T1 *P. lamia* was the rarest of 8 species I attracted to tuna baits. In T2 it was the second rarest of 10 species. This increased rarity of *P. lamia* in bait samples more probably reflects its hypogaeic habits rather than its relative abundance (see below).

Data on the distribution and abundance of *P. lamia* based on tuna baiting are displayed in Table 2. In T1 the number of bait stations attracting *P. lamia* changed from 4 in 1976 to 10 in 1977, while in T2 the number of baits attracting *P. lamia* changed little. Despite this dramatic change in T1, the number of sites containing *P. lamia* remained relatively constant between years for both T1 and T2. Combining both years, *P. lamia* occupied a total of 6 sites in T1 and 8 sites in T2. Similar to the litter samples, these results suggest that there are between 4 and 6 colonies along T1 and 7–8 distinct colonies along T2.

Correspondence between sites occupied by *P. lamia* in 1975, 1976 and 1977 differed along the two transects. In T1, the sites containing *P. lamia* as indicated by litter sampling in 1975 overlapped 100% with sites occupied in 1976 but only 29% with those occupied in 1977. Sites occupied in 1976 and 1977 overlapped by only 17%. In contrast, overlap between sites occupied in T2 was uniformly high. Sites occupied during litter sampling overlapped 88% with sites occupied during baiting in 1976 and 100% with sites occupied during baiting in 1977. Similarly, the 1976 baiting and the 1977 baiting shared 88% of their occupied sites. These data suggest that the distribution of *P. lamia* in T2 is more stable than that in T1.

SPATIAL AND TEMPORAL DISTRIBUTION IN QUADRATS: Figure 1 shows the spatial distributions of baits that attracted *P. lamia* workers over 24 hours in each of the four 100 m^2 quadrats. The number of baits visited

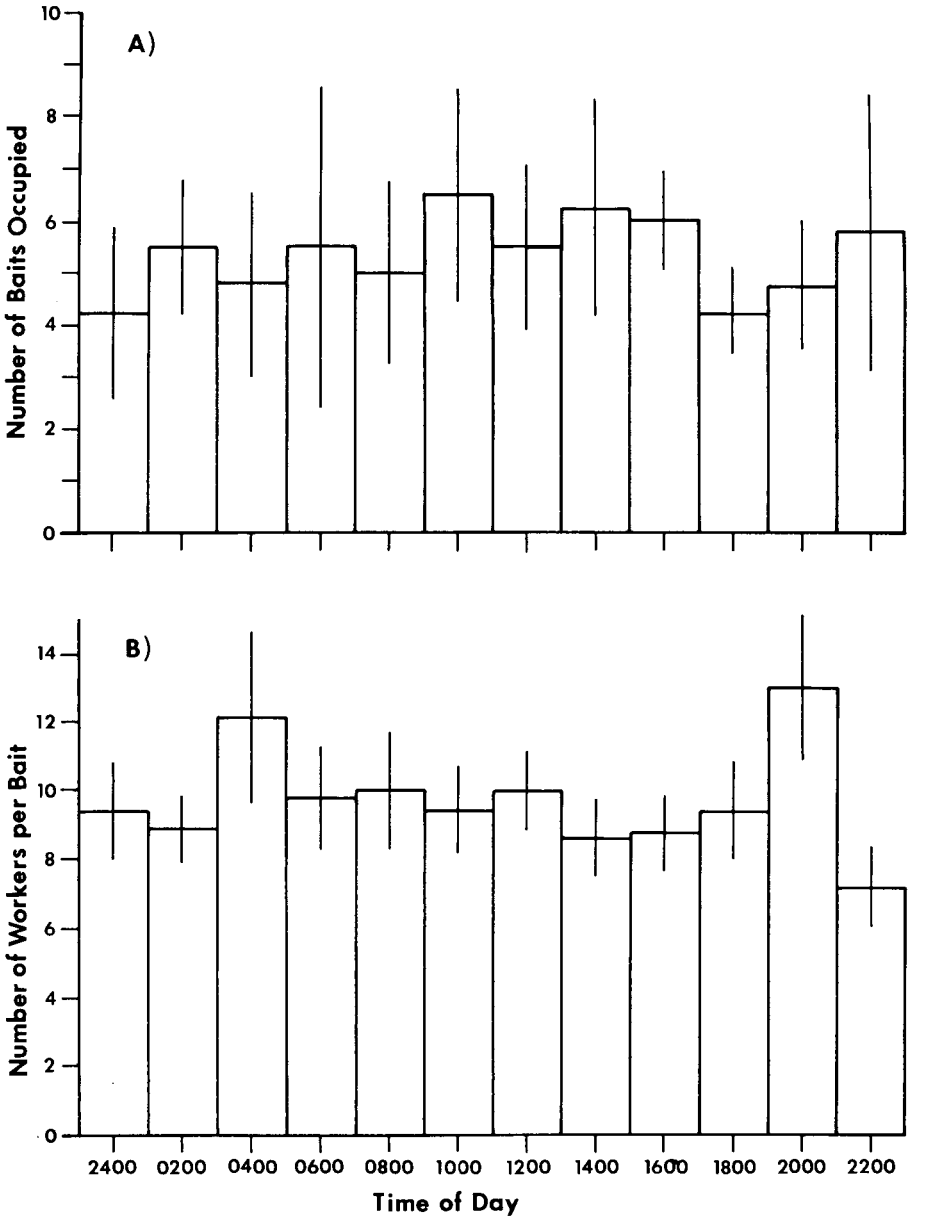

Fig. 2. Diel activity patterns of *Pheidole lamia* assessed during 24 hour censuses. (A) Mean number of baits occupied per 100 m^2 quadrat. (B) Mean number of minor workers per bait summed over all 4 quadrats. Lines through bars are standard errors.

ranged from a low of 9 in Quadrat 1 (Q1) to a high of 21 in Quadrat 3 (Q3). Nineteen baits were visited in Quadrat 4 (Q4) and 20 in Quadrat 2 (Q2).

Although the spatial distribution of bait visitations suggests some degree of clumping in all quadrats, it is not sufficiently distinct to accurately estimate the number of colonies in each quadrat. One or possibly 2 colonies appear active in Q1, while each of the other quadrats probably contain 2 or more colonies of *P. lamia*. A more accurate estimate would require the location of nest entrances or knowledge of the maximum foraging distance of workers. The extremely inconspicuous nest entrances and the hypogaeic foraging habits of *P. lamia* make this information difficult to obtain.

Since 1976 I have found a total of 3 *P. lamia* nest entrances, one in site 10 of T2, one in Q1 and one in Q4 (Fig. 1). These entrances were 1–2 mm in diameter, had little or no loose dirt or debris around them, and in two cases were obscured by leaf litter. In each case I located the entrance by following workers back from baits less than .5 m away. Nest entrances more than a meter from an occupied bait probably remained undetected because foraging workers invariably disappeared into the litter shortly after leaving the bait. In contrast to other species of *Pheidole* present in the area, I have never seen *P. lamia* workers run over the surface of the leaf litter for more than 1 m. This behavior also made it impossible to determine how far workers will forage from their nest site. The single nest entrance discovered in Q1 may account for the spatial pattern of visitations in this quadrat, however this is less likely to be true in Q4 (See Fig. 1).

Like most of the litter foraging ant species at Brackenridge Field Laboratory, *P. lamia* shows little diel pattern in foraging activity (Fig. 2). Baits in all quadrats continued to attract *P. lamia* workers throughout the 24 hour census periods. In fact, the mean number of baits occupied was almost constant (Fig. 2A). Similarly, the mean number of workers per bait varied little, usually staying near 10 (Fig. 2B). The number of workers at individual baits ranged between 5 and occasionally up to 50 or 60. Virtually all workers attracted to baits belonged to the minor subcaste. I very rarely saw major workers at a bait and never observed them to participate in any foraging task.

Although I did not directly assess the size of *P. lamia* colonies by excavating nests and counting workers, several lines of indirect evidence suggest that colonies of *P. lamia* in the Austin area are much larger than previously suggested (Wheeler, 1901; Gregg, 1956; Buren et al., 1977). First, as already mentioned, the number of minor workers at individual baits occasionally reached 50 or 60. Second, several adjacent baits sometimes attracted 20–30 minor workers each. If these workers were all from the same colony, which seems likely, then colonies of *P. lamia* certainly contain more than the 25–50 workers suspected by Wheeler (1901). Third, during the 24 hour census periods, *P. lamia* maintained an average of 7–13 minor

workers/bait (Fig. 2B), while *P. dentata* maintained an average of 10–20 minor workers/bait. If the level of activity in *P. lamia* and *P. dentata* colonies are roughly equivalent and tuna bait is equally attractive to both species, then the average number of *P. lamia* workers at baits suggests that colonies may contain as many workers as a small mature colony of *P. dentata*. A healthy mature colony of *P. dentata* at Brackenridge Field Laboratory typically contains 1600–3200 minor workers and 400–800 major workers (Feener, pers. obs.). Thus I would not be at all surprised if *P. lamia* colonies in the Austin area are as large as those collected in Florida with approximately 1000 minor workers (Buren et al. 1977).

Discussion

The results presented in this paper should help to clarify several aspects of the distribution and biology of *Pheidole lamia*. First, *P. lamia* is not confined to undisturbed tracts of moist deciduous forest (Gregg, 1956) or deciduous-coniferous woodland (Gregg, 1956; Buren et al., 1977). In the Austin area, this species appears to be a common component of the ant fauna of previously disturbed oak-hackberry woodland now undergoing secondary succession. This fact is consistent with the report of *P. lamia* nesting in open fields (Buren et al., 1977).

Second, in contrast to the general impression expressed in the literature (Wheeler, 1901, 1908; Gregg, 1956; Buren et al., 1977), *P. lamia* is not rare at its type locality of Austin, Texas. The presumed rarity of *P. lamia* is more the result of its inconspicuous nesting sites and hypogaeic foraging habits rather than its patchy distribution. *P. lamia* does not appear to nest commonly under rocks as supposed by Wheeler (1908), but nests directly in soil under leaf litter. As a result of these nesting habits, this species will appear more rare to general collectors than other hypogaeic species that utilize more easily sampled nest sites such as under rocks or logs.

Third, spatial patterns of foraging activity at tuna baits suggests that colonies of *P. lamia* contain many more workers than suggested by Wheeler (1901). Colony size is probably near 500–1500 minor workers, the same order of magnitude found in colonies collected in Florida (Buren et al. 1977). The fact that Austin is a geographical "fringe area" for *P. lamia* does not necessarily imply either small colony size or a patchy distribution of colonies (Gregg, 1956; Buren et al., 1977). This pattern also appears to be true for at least one other species of *Pheidole*. Austin is probably close to the western limit of the range of *P. dentata* (Creighton, 1950), but this species is nevertheless one of the most frequently encountered litter-foraging species in both disturbed and mature woodlands around Austin. Furthermore, my observations indicate that *P. dentata* colony size in Austin is about the same as it is in Florida (Wilson and Metcalf in Oster and Wilson, 1978). Although *P. dentata* can be found on the Edwards Plateau west of

Austin, it is restricted to patches of riparian woodland and is not particularly common. Thus the western limits of both *P. lamia* and *P. dentata* are more probably set by the abrupt ecological transition along the Balcones Fault rather than a more continuous deterioration of favorable ecological conditions across their geographical ranges.

Literature Cited

Buren, W. F., M. A. Naves, and T. C. Carlysle. 1977. False phragmosis and apparent specialization for subterranean warfare in *Pheidole lamia* Wheeler (Hymenoptera: Formicidae). J. Georgia Entomol. Soc. 12:96–100.

Creighton, W. S. 1950. The ants of North America. Bull. Mus. Comp. Zool. 104:1–585.

Gregg, R. E. 1956. An extension of range for the ant *Pheidole lamia* Wheeler (Hymenoptera: Formicidae). Entomol. News 67:37–39.

Oster, G. F., and E. O. Wilson. 1978. Caste and Ecology in Social Insects. Princeton University Press, Princeton, NJ. 352 pp.

Smith, M. R. 1931. An additional annotated list of the ants of Mississippi (Hymenoptera: Formicidae). Entomol. News 42:16–25.

Wheeler, W. M. 1901. The compound and mixed nests of American ants. Amer. Natur. 35:513–539.

———. 1908. The ants of Texas, New Mexico and Arizona. Bull. Amer. Mus. Nat. Hist. 24:117–158.